Report No. FHWA/MT-90/005

SYNOPSIS, MONTANA EXPERIMENTAL HIGHWAY PROJECTS

1975-1990

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FEDERAL HIGHWAY ADMINISTRATION
US DEPARTMENT OF TRANSPORTATION

MARCH, 1991

Research Management Unit

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA/MT - 90/005		

4. Title and Subtitle	5. Report Date
SYNOPSIS, MONTANA EXPERIMENTAL HIGHWAY PROJECTS - 1975 TO 1990.	March, 1991
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Garber, R.A. & Strizich, M.R.	
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Research Program Office Montana Department of Highways 2710 Prospect Avenue Helena, MT 59620	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	FINAL 1-1-75 Through 12-31-90
Research Program Office Montana Department of Highways 2701 Prospect Avenue Helena, MT 59620	14. Sponsoring Agency Code

15. Supplementary Notes

Report was prepared using H.P.R. funding, Project No. 8010.

16. Abstract

Brief abstracts of about 40 highway highway experimental projects constructed in Montana during the period of 1975 to 1990. Reports on the Springdale-Big Timber Pavement Test Sections on Interstate 90 (20 individual test sections) are available separately.

17. Key Words	18. Distribution Statement
Experimental Highway Projects; Experimental Pavement Test Sections	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
None	none	27	

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1990 Status Reports
Billings District Experimental Projects

Project No.: T-U-TQ-F 9010(10) U1
Location: 27th St. - Billings (150' south of Montana Avenue)
Title: Railroad crossing surfaces other than western softwood or concrete
Date Visited: 4-30-90

There were two gumwood (Eastern hardwood) crossings placed at the two southernmost railroad crossings when this project was constructed in 1977. Since that time, those two rail lines (sidings) have been removed along with the gumwood surfacings. Asphalt mix was used to fill in where these crossings were located originally.

A second type of crossing in this experiment was a polyethylene "T-core" crossing. This crossing was placed at the third set of tracks as you travel north. This crossing exhibited serious distress a few years after it was installed. It was repaired at the time but now is again in very bad shape. The crossing surface has essentially failed in both directions of traffic and is in need of immediate replacement.

The final type of crossing surface was a Goodyear rubber product. This surfacing was placed at the northernmost set of tracks. It was by far the most expensive, but its superior performance appears to have justified the high cost. The rubber surfacing is in excellent shape after 13 years. It still provides a very smooth ride over the railroad tracks and shows few signs of deterioration. There is one fairly large cut in the rubber surface that appears to be the result of a snowplow impact. This cut seemingly occurred soon after the original installation and has not seriously affected the performance of the surfacing.

1990 photos available.

Project No.: I 90-7(18)364
Structure
Location: FAS 298 over Interstate 90 at Big Timber
Title: Onflex - 25 Bridgedeck Expansion Joint
Date Visited: 4-30-90

These elastomeric rubber joints overall appeared to be in very good shape. They were constructed in 1979. There are smaller gouges or tears in the curb portion of the joints in two locations, and these appear to have been caused by snowplows. The gouges do not look like they will affect the performance of the joint system in any way.

There do not appear to be any other problems with the joints at this time. Future problems could arise if the sand and gravel used on the

bridge during the winter begins to work down into the joints. This may happen since considerable sanding material was observed on the bridge during this visit. This same observation was also made in a 1983 report, however. 1990 photos available.

Project No.: **FI 90-9(50)486**
Location: **Hardin - 7 Miles West**
Title: **Grouted Steel Lining Inside a Failing Steel Pipe to Accept Transfer of Earth Load**
Date Visited: 5-22-90

Everything looked to be in excellent shape. There is only a little muck on the bottom of the pipe (not even an inch). The north end is fairly dry but the southernmost quarter of the pipe has standing water in it. Because the water is very alkaline, this pool should be eliminated. This could perhaps be done by improving the drainage. This grouted liner was installed in 1982. 1990 photos available.

Project No.: **ID 90-9(36)531 U2**
Location: **Lodge Grass - South**
Title: **Foamix (Foamed Asphalt-Silty Sand Mixture) as a Pavement Base Course and Surfacing Support Layer**
Date Visited: 5-22-90

This project was overlaid during the summer of 1988. The condition of the new overlay is very good. All three foamix projects were paved in the summer of 1985, using a 12" layer of foamix as the pavement base course. The foamix then received a 3.5" surface wear course of regular grade "B" asphalt. The premature failure of the wear course has been attributed to various factors, such as "high flexure" of the foamix support layer and at least some stripping of asphalt within the surface wear course.

Project No. **ID 90-9(62)543**
Location: **Wyola - South**
Title: **Foamix (Foamed Asphalt-Silty Sand Mixture) as a Pavement Base Course and Surfacing Support Layer**
Date Visited: 5-22-90

This Foamix project is in much better shape than the Wyoming Line- No project. There is some alligator cracking around the centerline in places and there are a few maintenance patches. There is moderate transverse cracking and minor rutting but neither should seemingly be a cause for concern. This project is scheduled to be overlayed during the summer of 1991. Pictures are available in the Research Office.

Project No.: ID 90-9(38)549
Location: Wyoming Line - North
Title: Foamix (Foamed Asphalt-Silty Sand Mixture) as a Pavement Base Course and Surfacing Support Layer
Date Visited: 5-22-90

The asphalt surface on this Foamix project is in very bad shape. There are numerous maintenance patches and even these have alligator cracking. There are areas of alligator cracking throughout this project. The ride through this section of road is very rough and it badly needs the overlay scheduled for the summer of 1991. Pictures available.

1990 Status Reports
Missoula District Experimental Projects

Project No: RTF 71-1(6)0
Location: Reserve Street Overpass
Title: Novophalt-modified asphalt pavement overlay
Date Visited: 8/20/90

This project was constructed in the fall of 1987. There is no visible difference between the Novophalt sections and the 120/150 and 85/100 pen. grade control sections. All three types of paving material are doing very well. There is no visible cracking and insignificant rutting at this time.

Photographs of the Novophalt and the control sections are available in the Research Office.

Project No: IR 90-2(75)106
Location: Missoula - Bonner
Title: Milling and other rehabilitative measures for concrete pavement
Date Visited: 8/20/90

The milling and other work was done three years ago and has seemingly been very effective so far. The ride over the milled area is still quite smooth. Photographs available in the Research Office.

Project No: IR 90-1(105)15
Location: Haugan Weigh Station and Blackfoot River Bridge near Bonner
Title: Remote electronic surveillance of weather and pavement snow/ice conditions by SSI/SCAN 16 System
Date Visited: 8/21/90

The remote weather stations were installed in 1989 and are providing valuable road/weather information according to Rusty Wrigg, Maintenance Chief in Missoula. He feels this is particularly true under inclement weather conditions. There are two remote sensing stations, one at Haugan, the other at Bonner; both on the Interstate. Each station consists of a weather tower and inlaid pavement sensors. There are two pavement sensors at Haugan and four either adjacent to or in the Blackfoot River Bridge deck. The stations appear to be well constructed and should provide service for many years.

Current weather/pavement conditions at either station can be immediately accessed by use of portable lap-top computers in the Missoula District, or in the Helena Maintenance Division Office.

The system overall seems to working very well at this early point in time. This is in contrast to the earlier installation in Billings, which was generally inoperative and largely a catastrophe.

Project No: **RF BRF 100(15)**
Location: **Columbia Falls - E & W**
Title: **FEL-SPAN Bridgedeck Expansion Joints**
Date Visited: 9/10/90

The elastomeric joints appear to be in excellent shape. The only noticeable problem was at the very north end of both joints. The rubber has been torn in the vertical part of the curb face. This does not appear to be a serious problem. The rest of the joints do not appear to have suffered any damage and exhibit little wear. Overall, performance is very good considering that these joints were installed in 1977.

Photos are available in the Research Office.

Project No: **IR 90-1(109)23**
Location: **Bridges at Drexel (W. of St. Regis)**
Title: **Bridgedeck sealing with High Molecular Weight Methacrylate (HMWM) Sealing Compound**

Bridges at project stations 169+72 and 183+57 were cleaned and then sealed with HMWM compound - a liquid - during August 1990. The purpose of the HMWM application is to limit the intrusion of salt and moisture into the bridgedeck; thus to prolong the life of the reinforcing steel. Contact Larry Chezik, FPM; Jim Ferguson - Construction Bureau; or Nigel Mends - Bridge Bureau, for more information.

Project No: **F 5-4(3)160**
Location: **Dickey Lake - N & S (Northwest of Whitefish)**
and
Darby - N & S (South of Hamilton)
Title: **Blended Asphalts to Improve Long-Term Performance (Implementation of HP-GPC Research)**
Date Visited: 3/29/90 & 7/17/90 (Dickey Lake - N & S)

Construction of blended asphalt pavement test sections, including control sections, was completed on both projects during 1990. Reports documenting the construction are now past due from the Area and Division offices. Renewed efforts will be made to obtain these reports.

The objective of blending is to combine or integrate two asphalts of dissimilar HP-GPC (molecular size composition) characteristics into one asphalt in order to improve the HP-GPC characteristics, and hopefully,

long term pavement performance - namely a reduction or elimination of transverse thermal cracking.

A third, suitable project to complete the initial round of the experiment is currently being sought.

Project No.: F 5-4(3)160
Location: Dickey Lake - N & S (Northwest of Whitefish)
Title: Reinforced Roadway Fills Using "Tensar Geogrid" Thermoplastic Matrix
Date Visited: 3-29-90 & 7-17-90

Difficult terrain on this project dictated steep fill embankments above the shoreline of Dickey Lake in order to fit the roadway between the lake and the abutting mountain side. The thermoplastic geogrid was therefore interspersed in layers within the fill to keep the roadbed from sliding towards the lake. This project was completed in 1990, and a construction report is pending.

Project No.: IR 94-7(15)233
Location: Wibaux - East & West
Title: Cold Recycling
Date Visited: 5-2-90

The removal, stockpiling and cold recycling of the original pavement was completed in 1979. It was a seven-mile project that generally did not meet expectations. Various problems plagued the project, including placement of the recycled material in very cool, fall weather; compaction problems; etc. The people in the Glendive office were clearly not impressed with the results they had received from the cold recycling process. They had a lot of maintenance problems with this section of road until it was overlayed in 1987. With the new overlay, the surface is now in excellent shape.

Project No.: I 94-4(34)148
Location: Shirley - West
Title: Yielding Seam Structural Plate Pipe Culvert
Date Visited: 5-2-90

Spring Creek

There are numerous seeps of water located around the circumference of this culvert, emitting from the plate overlaps. At least one of these flows may seemingly be causing problems at the north end of the pipe. Water is seeping in from both the top and the bottom. It does not appear as though any corrective measures have been taken. The pipe diameter was measured in three locations using an extensometer. The readings were as follows:

Southern - Horizontal position - 10' 6.405"
Northern - Horizontal position - 10' 6.021"
Vertical position - 4' 2.837"

Deep Creek

The south entrance to this culvert has had a number of bolts either come loose or get sheared off. This has only occurred at the beginning lip of the pipe and the rest of the culvert looks to be in excellent condition. This pipe developed some leaking through the top joint areas after it was first installed, but this problem was corrected by coating the top of the pipe with a sealant. This sealant is clearly visible and appears to be doing its job. This pipe was also measured using an extensometer. The readings were as follows:

Southern - Horizontal position - 13' .552"
Northern - Horizontal position - 13' .000± (couldn't be more accurate because of trouble with the extensometer)
No attachments for the vertical measurements.

Project No.: **F-HES 37-3(2)70**
Location: **Ashland - East**
Title **Rapid Setting Rubberized Asphalt Overlay**
Date Visited: 5-23-90

This project was done in the last couple of years and still appears to be in very good shape. There is minor thermal cracking. The ruts at milepost 77 are perhaps typical and were measured as follows:

Eastbound Lane	Westbound Lane
Inside Wheel Path - 3/16"	Inside Wheel Path - 3/16"
Outside Wheel Path - 1/8"	Outside Wheel Path - 1/8"

Pictures available.

Project No.: **IR 94-5(25)185**
Location: **Prairie County Line - West**
Title **"Kraton" & "Polybilt" Modified Asphalt Overlays to Control Wheelpath Rutting**
Date Visited: 5-01-90

This experimental construction has been incorporated in the plans of the Prairie County - West project, and includes four one-mile test sections. This project was let to contract in August, 1990, and actual paving will take place in the Spring or Summer of 1991. This project results from research conducted in the Department of Civil and Ag. Engineering at Montana State University under the direction of Dr. Joe Armijo. MSU will also monitor construction and long term performance.

In the MSU research Carbon-black, Kraton, & Polybilt all performed equally well: the carbon-black was not used on this project since we already have a test section on I-90, Springdale to Big Timber (performing very well).

Pictures of the "before" situation available.

1990 STATUS REPORTS
Great Falls District Experimental Projects
(Formal Evaluations)

Project No: F-HES 24-3(11)83
Location: Rogers Pass - West (Test Section East From the Pass)
Title: Cold Recycled Asphalt Pavement Base
Date Visited: 4/17/90

This section of road is in pretty rough shape. A large part of it has already been covered by maintenance patches. There is very little rutting, but it has extensive cracking, both transverse and alligator. Most of the cracks have not been sealed by maintenance forces. This project was constructed in September of 1985, using a multi-function pavement recycling unit. This was a late fall project, in which there was snow and rain during some part of the recycling/paving/compaction operations.

Project No.: IR 15-8(39)351
Location: Shelby - N & S (SB Lanes) (Just S. of Shelby)
Title: Sawgrooves in newly placed, recycled asphalt to reduce transverse thermal cracks
Date Visited: 4/16/90

This section has been very recently overlayed, so it was impossible to come to any conclusions. The ride over this section is very good at present. The sawgrooves were originally constructed in October, 1982 and the section was overlayed during the Summer of 1989. The new surfacing is still relatively crack-free, but it is far too early to estimate the amount of reflective cracking that may eventually develop. Joints in the 1982 pavement were sawed to 1/3 and 1/4 of the recycled pavement depth. There was moderate development of transverse cracks between sawjoints in the earlier recycled pavement, and sawing to the specified depths and spacings was only marginally successful at this location.

Project No.: F 60-2(23)90
Location: Great Falls - 10th Avenue S.
Title: Novophalt Modified Asphalt Pavement Overlay
Date Visited: 4/16/90

The ride over this section of road was very smooth. The road is in excellent shape with no cracking and ruts that were not measurable in most areas. The ruts at the approaches to the stop lights were as deep as .04 inch, which is not even noticeable to the naked eye. This whole test section is holding up well and having no problems. It was constructed during the Summer of 1989. It has significantly less traffic than the abutting AC-20R test section.

Project No: F 60-2(23)90
Location: Great Falls - 10th Avenue S
Title: AC-20R Latex-Modified Asphalt Pavement Overlay
Date Visited: 4/16/90

The ride over this section of road was very smooth except for a several areas that are developing ripples. These are in the braking areas and on the hill in the middle of the test section. The ripples on the hill were the worst. There was no cracking in the test section but there was pervasive, minor rutting. The deepest ruts in the fall of 1989 were at the stop lights and were up to .14" deep. The shallowest rut measured was .07" and the average rut depth over the entire section was .10". The ruts all developed within two months of completion of construction, which was in July of 1989. Since then the ruts have apparently deepened through the summer months of 1990. Measurements are pending by District personnel.

Project No: F 24-4(5)117
Location: Simms - West
Title: Thermoplastic Matrix to Reduce Base Course Aggregate Requirements
Date Visited: 4/17/90

This project is currently under construction. It will be completed sometime during the Summer of 1990. The Construction Report is pending.

Project No.: IR 15-8(44)380
Location: Kevin Interchange - No.
Title: AC-20R Latex Modified, Dense-Graded Asphalt Seal Coat/Thin Overlay
Date Visited: 4/16/90

This section of road looked to be in excellent shape. There was very little cracking and no measurable rutting. The dense-graded asphalt is visibly different from regular seal coats, with pea-sized aggregate predominating. The excellent shape of the overlay at this time is partially due to it's being built in May of 1989.

Project No.: IR 15-5(76)283
Location: Great Falls - Vaughn
Title: Rubber asphalt membrane, on shoulders and earth-covered, and other treatments to control subgrade swelling.
Date Visited: 4/16/90

This project was inspected as on this date, but little can be learned by way of visual observation and ride quality. The membranes and other treatments were installed in November of 1983. The project pavements

were overlayed in 1988 and the ride as yet is quite smooth. In the first four or five years following construction of the membranes, vertical curtains, etc., there was an extended period of drought which somewhat negated the value of the installations. A more intensive investigation, with coring into the subgrade, and other tests, will be necessary in order to develop definitive conclusions about this experimental installation.

Project No.: **IR 15-7(20)312**
Location: **Brady - N & S (SB Lanes)**
Title: **Sawgrooves in newly placed recycled asphalt pavement to reduce transverse thermal cracks**
Date Visited: 4/16/90

This section of road was overlayed during the Summer of 1989. This construction essentially terminated the experiment constructed in June of 1982. The sawgrooves on the original, 1982 project did little, if anything, to control the amount or location of subsequent reflective cracking. There was extensive crack development between sawgrooves. Sawgrooves of the depths and spacings at this location were therefore not successful. The extreme swelling characteristics of the subgrade soils seemingly contributed to the severity of the cracking problem at this location.

Project No: **IR 15-7(21)323**
Location: **Brady - N & S (Northbound Lanes)**
Title: **Pavement and roadbed treatments to delay or prevent reoccurrence of sharp upward deformations (humps) along the numerous transverse thermal cracks.**
Date Visited: 4/16/90

Discussion: This section of Interstate highway was originally constructed in 1973. By the early 1980s severe pavement deformations - sharp humps - had developed along the transverse cracks. The ride over this section was extremely rough, and ultimately safety concerns began to surface.

This project was located in an area of highly expansive, bentonitic clay soils; also in an area of limited deposits of mineral aggregates, those being of marginal quality. Transverse thermal cracks had developed in the original 1973 asphalt paving at 30'-40' intervals. Surface moisture them carried into the subgrade through the cracks and also from the barrow areas. Subsurface drainage is poor to non-existent. Seemingly, with higher infiltration at the cracks, the underlying clays began to swell at differential rates, causing the asphalt pavement to curl upwards at the cracks.

In conjunction with planned 1985 recycling and overlays; it was decided to try a number of experimental features to hopefully restrict moisture flow into the highway subgrade. This in turn would then delay or prevent the reoccurrence of the humps.

The experimental features are as follows:

A. Crack sealing roto-milled asphalt pavement prior to overlay.

B. Impervious vertical membrane (buried curtains) along the pavement edge.

C. Asphalted fabric membrane on roto-milled pavement to form seal beneath overlay.

D. Rubberized asphalt membrane on roto-milled pavement to form seal beneath overlay.

E. Asphalt roto-milling and overlay (essentially the "control" section).

F. Roadway reconstruction with a 24" deep gravel base.

G. Bituthene sheet/crack treatment prior to overlay (band-aid).

H. Various lapped and folded fabric crack treatments prior to overlay (band-aid).

I. Sawjoints (12 inch depth) in newly resurfaced asphalt pavement to reduce thermal cracks (with backer-rods and rubberized crack sealer).

Performance to date:

Visual observation and ride quality are the only methods which have been employed to monitor the performance of the experimental features.

As perhaps expected, most or all of the original transverse cracks have reflected upwards through the newer overlayments.

The major exception to this is the deep sawjoints which have largely controlled the incidence of reflective cracking. The sealant used in the sawjoints, however, is now pulling away from the sides of the cuts, leaving yawning holes along most of the joints. Work to reseal the sawjoints is therefore strongly suggested.

The transverse cracks, in contrast, have been painstakingly sealed by maintenance forces, and the condition of the seals is generally quite good. Wheelpath rutting on the entire project is still negligible.

Conclusions:

At five years, ride quality is still good to excellent throughout the project. There are small but noticeable "thumps" as you ride over each sawjoint or transverse crack on this project, regardless of the treatment involved. There

are no visible humps as yet, when you actually inspect the cracks and adjacent paving on foot. Overall, one has to suspect that some swelling is occurring.

The "thumps" on the straight roto-mill/overlay section give the perception of being slightly more pronounced then the sections with the experimental improvements. This may suggest that all of the various experimental features are, to some minor degree, serving their intended purpose. The larger question of cost-effectiveness remains unanswered at this point in time.

1990 STATUS REPORTS
Great Falls District Experimental Projects
(Informal Evaluations)

Project No: F 57-2(8)10
Location: Raynesford - Geyser
Title: Use of AC-20R as an experimental paving asphalt
Date Visited: 4/18/90

The test section consisted of a 9.453 mile section of AC-20R rubberized asphalt overlay placed in 1988. The 2.0 mile "control" section of overlay was not directly comparable in several respects. One of these differences was the source of the asphalt cement. The asphalt used in making the AC-20R was AC 120/150 produced by Exxon, while the "straight" AC 85/100 was produced by MRC. Further, Marshall design factors were also different for the test and control sections. The AC-20R had 75 blow design while the AC 85/100 had 50 blow design. This difference could have led to different compactive efforts being used during construction of the two sections. Furthermore, the AC-20R mixture was constructed with a production temperature around 330°F while the "control" section utilized a production temperature of approximately 290°F.

The entire length of the project, basically the two test sections, appeared to be in excellent shape. There was no measurable rutting throughout the length of the project. The only noticeable difference between the two sections was with respect to the amount of transverse cracking. There are substantially more cracks in the AC 85/100 section than there are in the AC-20R test section. The cracks in both sections had been sealed. The ride over both sections is exceptionally smooth.

Project No.: F 10-1949)11
Location: Great Falls - North
Title: In-Place, Cold Recycled Asphalt Pavement
Date Visited: 4/18/90

This 15 mile section of road had been chipsealed sometime after the in-place recycling in the summer of 1988. The road surface appeared to be in very good shape with a small amount of transverse cracking. The cracks had all been sealed by maintenance forces and the ride over this section was exceptionally smooth. This project consisted of cold, in-place recycling using a multi-function paving train (milling, particle sizing, addition of recycling agent, return to the roadbed, spreading and compaction). The recycling agent used on this project was a high-float emulsion, specifically HF-100 product. The success of this project, in some measure, can perhaps be attributed to its being performed during hot, dry August weather.

Project No.: F 1-4(5)271
Location: Shelby - West
Title: CRS-2 Seal and cover embedment on plant mix overlays
Date Visited: 4/16/90

The road seemingly had a very recent chip seal on it so it apparently wasn't possible to observe the condition of the earlier surface.* In any event the existing surfacing was in very good to excellent condition. Cracks were fairly numerous but had been sealed by maintenance forces. The ride over this section of road was smooth. This CRS-2 project was constructed in June of 1984. This project was unique to the Great Falls District in that they had used Hi-float emulsions almost exclusively for their chip-seals.

Project No.: F 24-3(5)100
Location: Rogers Pass East (Middle Section)
Title: Seal and cover embedment on plant mix surfacing
Date Visited: 4/17/90

The road in this project looked to be in good shape. There were quite a few transverse cracks. At the base of a hill just west of Bowmans Corner I noticed some fairly deep ruts in the westbound lane. The ride over this section of road was fairly smooth and the cracks had been sealed by maintenance crews. The seal seemed to be in excellent shape but it again looked like it was a fairly recent chip seal and had been put down since the test section was constructed in June of 1984.

*No one in the District, after repeated phone calls, could tell us if the section had been recently chip sealed or not.

1990 Status Report
Butte District Experimental Projects

Project No.: IR 90-6(50)286
Location: Logan - Bozeman
Title: Asphalt overlay on concrete pavement to resist continued slab faulting and improve ride quality
Date Visited: 7/9/90

The two one-half mile sections of asphalt overlay were constructed during the summer of 1989. They appear to be in excellent shape at this time, and the ride after one year is still very good. There are virtually no reflected cracks as yet over the sawjoints in the underlying concrete pavement. This may perhaps be attributable to a somewhat mild 1989 - 1990 winter.

The grinding/leveling operation performed on adjoining concrete sections in 1989 is also providing good ride characteristics at this point, but again the time element must be considered. The grinding treatment is about twice as expensive as the asphalt overlay.

Project No.: F 8-2(22)28-U2
Location: US 12 West of Helena (McDonald Pass)
Title: "Plus-ride" Asphalt Pavement Overlay
Date Visited: Various times, 1990

The "Plus-ride" Test Section extends 0.967 miles westerly from the Frontier Town access road. It is the second lift of second-stage paving on this project. This Plus-ride is actually a top-surfacing course, 0.13 ft. deep, modified by the addition of pea-sized rubber granules (and preceded by rejection of the same pea-sized mineral aggregate). There are control sections of grade "B" plant mix overlays, topped with seal and cover, adjoining both ends of the Plus-ride test section. Both the "Plus-ride" and control sections were placed in September 1983, under the same contract.

The overall condition of the "Plus-ride" section after seven years exposure is still excellent, and is noticeably better than the control which is now exhibiting considerable distress (seal and cover on the west end is virtually gone).

As to specific performance attributes, the "Plus-ride" overlay in this location does not shed or repel ice/snow pack accumulations as once claimed by the product developer (Skagit of Sweden). The "Plus-ride", however, has shown superior wear characteristics, such as resistance to chain damage, studded-tire wear/polishing and probably even wheel path rutting. Finally, tire-pavement noise - both inside and outside the vehicle - is markedly lower on the "Plus-ride".

From the above it would seem reasonable that the Dept. should give serious consideration to further use of "Plus-ride" pavements. Curving, shaded areas along our canyon routes would seem to be locations where the added, initial expense could perhaps be justified.

Project No.: **IR 90-5(44)250**
Location: **Whitehall - Cardwell**
Title: **Dynamic Compaction of Collapsible Soils under Interstate Roadway**

Extreme pavement distortions developed on this section of Interstate highway East of Butte, Montana, approximately 15 years after the original construction of the roadway. An extensive geologic investigation in 1983 revealed the presence of collapsible soils, typically 20 to 30 feet deep. This study also led to the recommendation of dynamic compaction, simply a large, very heavy weight repeatedly dropped from a considerable height.

Work began on the project in the fall of 1984, and several miles of the roadbed received dynamic compaction through the winter and spring months. Paving was completed in July, 1985.

After five years, the roadbed remains relatively flat and ride quality is generally good over the "dynamically" compacted portions of the project. Several Butte District people who travel the section on a daily basis feel that the ride quality is now beginning to deteriorate somewhat.

Project No.: **IR 90-5(44)250**
Location: **Whitehall - Cardwell**
Title: **Open graded friction course (OGFC) using "AC20R" Rubberized Asphalt Cement**

A one-mile test section using "AC20R" binder was placed in July, 1985, along with regular, non-modified OGFC over the balance of the project. Current condition of both the modified and non-modified portions of the project is still very good, except for loss of chips at the transverse thermal cracks. Some of the cracks are now quite wide and may be getting wider, with chips coming loose particularly on the "downstream" side of the crack. Curiously, the loss of chips at the cracks may be slightly worse on the "AC20R" test section compared to the rest of the project.

The transverse cracks have not been sealed on this project, and such treatment could possibly be beneficial in prolonging the life of the pavement.

Project No.: By Environmental Unit & District Maintenance Personnel
Location: US 87 East of Townsend
Title: "Swareflex" Deer Reflectors
Date Visited: 9/24/90

Based on a presentation by the manufacturer, a high deer kill area east of Townsend on US87 was originally selected as a trial site for installation of the reflectors in about 1985. Proportedly, the function of the headlight "reflectors" (actually refracting lenses) is to startle running or perambulating deer to keep them from crossing the traveled-way at night in front of approaching vehicles.

Although an eclipsed study, the data from the ½ mile test section east of Townsend suggested that the reflectors did little or nothing to reduce vehicle deer kills at this location. A similar installation of the same reflectors near Spokane, WA, studied under perhaps more carefully controlled conditions, recently indicated a statistically significant, but nonetheless very small, reduction of deer kills. The reflectors are also currently being studied in central Oregon.

During this visit I observed a dead deer in the barrow pit alongside the "reflectorized" section. As the "reflectors" are still in place, the dead animal may perhaps give some indication of the marginal value of the installation.

100% Solids Epoxy Lane Stripping Statewide

Project No.: IR 90-8(95)385
Location: Reedpoint
Title: 100% Solids Epoxy Lane Striping Applied to Asphalt Pavement
Date Visited: 5-1-90

The epoxy striping was put down in the eastbound lanes during April of 1985. Subsequently, the right and left shoulder lanes have both been largely painted over by maintenance crews. The epoxy centerline remains in place as originally applied. On the centerline the maintenance crews painted regular alkyd stripes to join up with the epoxy (i.e. parallel and abutting), but they did not paint over the centerline. The condition of the striping at three particular locations was observed on this visit. Pictures of all three locations are available in the Research Office.

Milepost 387

Both shoulder lanes have been painted over. The yellow left shoulder line does not have any visible epoxy. The white right shoulder line has places where the paint has flaked away and the epoxy is showing through. The epoxy is duller than the paint and appears to have a yellowish tint to it. The centerline has clearly defined areas of paint and epoxy. The epoxy appears faded in daylight viewing conditions, but overall remains in relatively good condition.

Milepost 389

The epoxy centerline has not been painted at all here. The epoxy at this location is very faded and worn. The yellow left shoulder lane has been completely painted over with none of the epoxy visible. The right shoulder lane again showed a marked contrast between the paint and the epoxy. When the sun came out briefly, the epoxy sparkled like it was laced with glitter. The sun had no similar effect on the regular paint.

Milepost 391

There was again a definite color difference in the right shoulder lane while the left lane had no noticeable areas of epoxy remaining. The epoxy in the centerline is very faded and worn-looking during daylight, but should still have good reflectivity at night.

100% Solids Epoxy Lane Stripping Statewide

Project No.: IR 94-4(35)210
Location: Glendive - East & West
Title: 100% Solid Epoxy Lane Striping Applied to PCC Pavement
Date Visited: 5-2-90

The epoxy on this project was put down in July of 1987. The epoxy in both lanes of the entire length of the project appears to be in excellent shape. The yellow seems to be particularly effective because it does not appear to be faded (or dull) during the day. The white epoxy does look a little bit faded during the day, but should still perform well at night. Sunlight on the epoxy made it glitter and it is assumed that a car's headlights at night would have the same effect. At all of the exits, a small portion of the epoxy had been painted over at the point where the exit lane left the interstate. Pictures of the striping are available in the Research Office.

Project No.: IR 90-9(63)503
Location: Dunmore Interchange
Title: Solid Epoxy Lane Striping Applied to Asphalt Pavement
Date Visited: 5-23-90

The epoxy striping on this project was placed in July, 1985. The right shoulder line is very dull and seems to be almost gray in color. The yellow left shoulder line is also very dull. The centerline looks to have been painted, with the paint alternating with the epoxy so that the epoxy is still visible. The epoxy is still very much intact with very little of it having peeled off. Pictures of this experiment are available in the Research Office.

Project No: I 90-1(98)39
Location: Sloway-Superior
Title: Epoxy Pavement Markings
Date Visited: 8/20/90

The epoxy striping on this project was placed in October, 1986, using materials supplied by the Poly Carb Company. The epoxy was completely repainted the following year with regular alkyd traffic paint, for unknown reasons. The epoxy striping had not failed, however.

Project No: I 15-2(49)124
Location: Butte - West and South
Title: Solid Epoxy Lane Striping Applied to PCC Pavement
Date Visited: 9/25/90

Epoxy striping was originally applied to this project on October 23-26, 1986. It performed quite well at first, but in the third and fourth years began to suffer both in reflectivity and from snowplow (chipping) damage. Consequently, the project was completely restriped in September, 1990 with regular alkyd paint being used on top of the faded epoxy striping. The four years actual service at this location would probably be typical for the epoxy product placed anywhere in Montana.

Under particular daylight viewing conditions, the "white" epoxy striping was almost indistinguishable from the concrete pavement, even when brand new. 1986 pictures of the striping are available.

Project No.: PMS 4140(61) U2
Location: Billings - Mossmain Weigh Station
Title: Inlaid Thermoplastic Pavement Markings Statewide
Date Visited: 5-1-90

The right shoulder lane on the frontage road had been painted over although it did not appear that it needed it. The double yellow centerline was in excellent shape, especially considering that the markings were installed in 1983. Overall, the thermoplastic markings in this location are in excellent shape and should last for a number of years. Pictures of the striping are available in the Research Office.

Project No.: PMS 4140(61) U3
Location: Miles City - Intersections with Main Street
Title: Inlaid Thermoplastic Pavement Markings Statewide
Date Visited: 5-1-90

4th Street

The white thermoplastic is cracking and beginning to peel in many places. It is also fairly faded. It has not been painted over, but will probably need to be replaced within the next year or two. The markings are in relatively good shape considering the heavy traffic at this location.

5th Street, 6th Street, and 8th Street

The thermoplastic at these locations is also cracking and peeling. It's been completely worn out in the wheel paths of the eastbound lane on the east side of all three intersections. These intersections will need to be remarked in the next year or so. The west approach of both these intersections seem to be holding up much better than the east approaches. All three intersections have fairly heavy traffic.

7th Street

There is heavy wear of the thermoplastic on all four approaches of the intersection. The markings should be replaced as soon as possible. This is the busiest of the six marked intersections in Miles City. This heavy traffic is most likely the reason for the advanced loss of the thermoplastic at this intersection.

9th Street

The thermoplastic at this intersection is cracked and wearing in the wheel paths, but otherwise looks to be in very good shape. It is in far better shape than the markings at the other five locations in Miles City probably due to a lesser amount of traffic. The markings should perform adequately for at least another two or three years.

All of the thermoplastic markings in Miles City were installed in 1983. They are all located in adjoining intersections, but there is a definite difference in the amount of traffic that each one receives.

Project No.: PMS 4140(61) U3
Location: Glendive - MT 16 & I-94
Title: Inlaid Thermoplastic Pavement Markings Statewide
Date Visited: 5-2-90

The arrow on the north approach of the intersection is in pretty rough shape and should be replaced immediately. The rest of the intersection appears to be in really good shape. The thermoplastic is showing some limited cracking and peeling, but neither is very extensive. It appears that the intersection has moderately heavy traffic on all legs. The markings were again put down in 1983 and are in excellent shape for their age. One of the engineers out of the Glendive office told me that they have received good results from all of the hot inlaid thermoplastic that they have used in that area. He also told me that this intersection would be totally reconstructed later this summer.

Project No.: PMS 4140(61) U3
Location: Sidney - Central Avenue & 488
Title: Inlaid Thermoplastic Pavement Markings Statewide
Date Visited: 5-2-90

The thermoplastic is not in as good of shape at the intersection of Central Avenue and Route 488 as it has been in other places. This appears to be the result of fairly heavy traffic and the poor condition of the road surface it was placed on. The markings on the east side, along with the wheel paths on all sides of the intersection, are almost completely worn off.

The markings at the intersection are still functioning, but should probably be replaced soon. The rest of the markings on Central Avenue are in very good shape except for the dotted centerline in both the northbound and southbound lanes between 8th and 7th Streets. These have faded so bad that they are only visible in a couple of areas.

Project No.: PMS 4140(61) U3
Location: Poplar - "F" Street and U.S. 2
Title: Inlaid Thermoplastic Pavement Markings Statewide
Date Visited: 5-2-90

The thermoplastic markings are in excellent shape, with much less cracking and peeling than in the other test sections. The only problem with them is that they appear to be much duller in color than they should be. This may be due in part to the excessive amount of sand that is still on the road surface. The thermoplastic was placed in 1983 and appears to have a number of years of service remaining.

Project No.: PMS 4140(61) U3
Location: Wolf Point - 6th Ave. No. & Alden Street
Title: Inlaid Thermoplastic Pavement Markings Statewide
Date Visited: 5-2-90

On the west side of the intersection there is no crosswalk, but the 24" white bar is in excellent shape. It appears that the crosswalk was never put in on this side, but was actually put in on the other side. This is just the opposite of what the plans called for. On the east side of the intersection, the westbound lane is in very good shape while the markings in the eastbound lane are falling apart. The road surface is in very poor condition wherever the markings are coming off the road.

Project No.: PMS 4140(61) U2
Location: Grassrange - U.S. 87 & Mont. 19
Title: Inlaid Thermoplastic Pavement Markings Statewide
Date Visited: 5-3-90

Overall, the thermoplastic is in very good to excellent shape. There is quite a bit of cracking, but very little peeling. The left turn arrow in the south end of the intersection is the only part of the markings that appear to be in really bad shape. Its poor condition appears to be due entirely to alligator cracking in the road surface. The cracks in the thermoplastic occur only where there are cracks in the road surface. The north end of the intersection is in the same shape as the south end. There is one problem area on this side too. The "ONLY" marking that is furthest north is peeling badly in a couple of areas. These areas, the "Y" and part of the "N", have been painted over by maintenance forces. The thermoplastic markings at this location were installed in 1983 and they appear to have at least a couple more years of service in them.

Inlaid Thermoplastic Pavement Markings Statewide

Project No.: PMS 4140(61) U2
Location: Eddies Corner - U.S. 87 & U.S. 191
Title: Inlaid Thermoplastic Pavement Markings Statewide
Date Visited: 5-3-90

The east and west legs of the intersection had no thermoplastic markings. All striping was in paint. The south end had about 20 feet of centerline that was thermoplastic, but the remaining markings had all been covered by a large maintenance patch in the northbound lane. The remaining thermoplastic markings are very dull and there are not many of them.

Project No: PMS 4140(61)U2
Location: Missoula - 6th Street and Arthur
Title: Inlaid thermoplastic Pavement Markings Statewide
Date Visited: 8/20/90

The inlaid thermoplastic markings at this intersection are all very worn and should be replaced soon. The markings on the north side of the intersection on Arthur St. are in the worst shape. The poor condition of the markings on that leg of the intersection is due to extensive alligator cracking of the pavement. Part of the 6th Street leg appears to have been chip sealed so only part of the markings remain, and those remaining are both worn and faded.

There are pictures of all the marking at all locations available in the Research Office.

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